

Section 5 - Network Assessments

Periodic network assessments are needed to establish and maintain optimum air monitoring networks. Simply stated, a network assessment is a structured evaluation of a monitoring network to determine if the goals and objectives for that network are being met in the most efficient way, accounting for budget, staffing, public information, technical, political and other factors. The following paragraphs describe the overall strategy for conducting network assessments as well as findings from the most recent national and regional assessments.

5.1 Network Assessment Overview

Network assessment is not a new process. State and local agencies historically have conducted annual network evaluations, and changes to monitoring networks have been undertaken and reported as part of this process. However, periodically, it is necessary to take a more holistic review on a multi-level basis: national, regional, and local agencies. As part of the Strategy it is recommended that a multi-level network assessment be conducted every five years.

The primary objectives of the network assessments are to ensure that the right parameters are being measured in the right locations, and that network costs are kept at a minimum. Some of the related secondary objectives include the following:

- Identify new data needs and associated technologies,
- Increase multi-pollutant sites vs. single pollutant sites,
- Increase network coverage,
- Reduce network redundancy,
- Preserve important trends sites, and
- Reduce manual methods in favor of continuous methods.

5.1.1 Role of National Assessments. The national assessments are intended to provide broad directional recommendations for information about potential network changes. The national assessments identify current and future data needs, and make recommendations for the implementation of new technologies. The national assessments also evaluate the existing networks in order to identify universal opportunities to reduce or eliminate existing monitoring activities and associated costs. The recommendations that come from the national assessment are intended to guide the more site specific regional assessments.

5.1.2 Role of Regional Assessments. Regional assessments are intended to identify site specific network changes to be made based on the broad recommendations from the national assessment. Detailed analyses should be made to identify where new monitors should be located, and to identify low value monitors that should be eliminated. After reviewing their recommendations with OAQPS, and State and local agencies, the Regional Office should include a list of specific network changes that are to be implemented in their final regional assessment.

See the preliminary guidance on conducting regional assessments at the end of this section for additional information.

5.1.3 Role of Local Assessments. As stated above, State and local agencies regularly conduct network evaluations. As a part of their regular network evaluations, SLTs would be asked to review and comment on the recommended network changes that would affect their monitoring activities. State and local agencies should carefully review each of the changes suggested by the RO. Ultimately, local agencies will be responsible for implementing the RO's final recommendation for network changes.

5.2 FY 2000 National Assessment

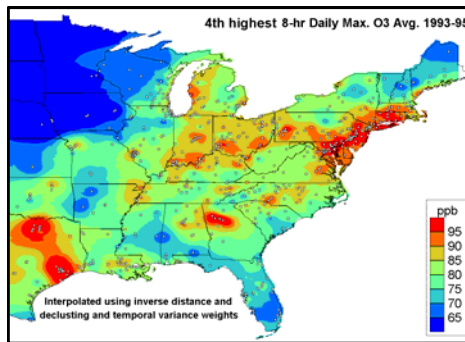
An example national assessment of the criteria pollutant networks was conducted in 2000 to catalyze subsequent regional level assessments. This assessment considered concentration level, site representation of area and population, and error uncertainty created by site removal as weighting parameters used to determine relative "value" of individual sites. The most widely applied factor inherent in most assessment approaches is related to site redundancy and can be estimated in a variety of ways. The national assessment calculated error uncertainty by modeling (i.e., interpolating between measurement sites) surface concentrations with and without a specific monitor with the difference reflecting uncertainty (Figure 5-1). Areas of low uncertainty (e.g., less than 5 ppb error difference for ozone) suggest that removal of a monitor would not compromise the ability to estimate air quality in the region of that monitor as nearby stations would provide adequate acceptable predictions.

The assessment approach was expanded to include additional weighting factors beyond error. Typical outputs for ozone networks (Figure 5-2) suggest that ozone sites clustered in urban areas yield less powerful information than sites located in sparsely monitored areas, especially in high growth regions like the southeast. However, this conclusion is more applicable to urban areas with more homogeneous conditions. This methodology was applied to all criteria pollutants with a variety of weighting schemes to provide a resource for more detailed regionalized assessments.

The key findings of the national network assessment are as follows:

- **Investment Needs:** New monitoring efforts are needed to support new air quality challenges, including monitoring for air toxics and new technology for criteria pollutants and precursor species. Air toxics have emerged as a top public health concern in many parts of the country, and a national air toxics monitoring network is currently under development under special funding for air toxics monitoring. New technology, especially continuous measurement methods for pollutants, such as fine particles, are needed to provide more complete, reliable, and timely air quality information, and to relieve the burden of manual sampling. Resources and guidance are needed for this activity.

Base case ozone surface all sites



Error surface after site removal

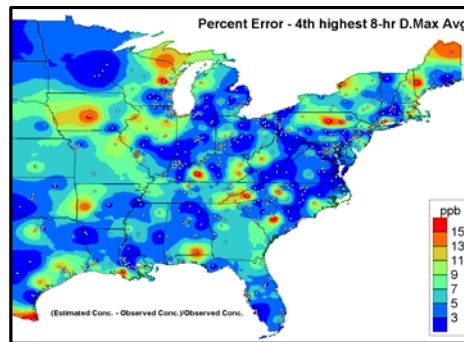


Figure 5-1. Surface depiction of estimated absolute errors (right) in ozone concentrations produced by removing existing monitors on a site by site basis, relative to base case (left). Areas showing low errors (<5 ppb) suggest neighboring monitors could accurately predict ozone in area of a removed site. Areas of high error suggest necessity to retain existing monitors and perhaps increase monitoring.

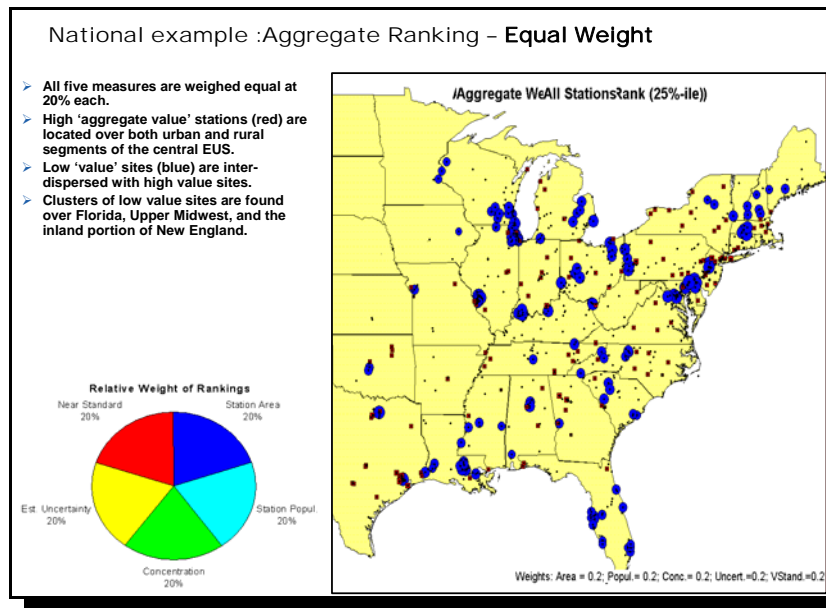


Figure 5-2. Aggregate assessment of 5 evenly weighted factors. Blue circles and red squares indicate the lowest and highest valued sites, respectively.

- **Divestment Opportunities:** To make more efficient use of existing monitoring resources and to help pay for (and justify additional resources) the new monitoring initiatives noted above, opportunities exist to reduce existing monitors. Two areas of potential divestment are suggested. First, many historical criteria pollutant monitoring networks have achieved their objective and demonstrate that there are no national (and, in most cases, regional) air quality problems for certain pollutants, including PM₁₀, SO₂, NO₂, CO and Pb. A

substantial reduction in the number of monitors for these pollutants should be considered. (However, considerations need to be made to retain a certain number of trace level monitors especially for SO₂ and CO because of their utility as tracers for certain sources of emissions.) As part of this adjustment, it may be desirable to relocate some of these sites to rural areas to provide regional air quality data. Second, there are many monitoring sites with only one (or a few) pollutants. To the extent possible, sites should be combined to form multi-pollutant monitoring stations. Any resource savings from such divestments must remain in the monitoring program for identified investment needs. A reasonable period of time is required to smoothly transition from established to new monitoring activities.

It should be noted that removal or relocation of monitors with historical regulatory applications creates a challenging intersection of policy and technical applications. Network assessments produce recommendations on removing or relocating samplers based largely on technical merit. In some instances, these recommendations may be in conflict with existing policy or other needs. For example, a recommendation that an ozone monitor be discontinued in a “nonattainment” county due to redundancy of neighboring sampling sites raises interesting policy/technical issues. These and other issues require attention in concert with technical recommendations developed through assessments. It should not be assumed that policy should override a technical recommendation, nor should technical approach override existing policy. Rather, reasonable solutions can be achieved on a case-by-case basis. To that end, the intersection between policy and network optimization, issues are being identified. The total perspective of such implications is currently under evaluation.

- **Importance of Regional Input:** The national analyses are intended to provide broad directional information about potential network changes. Regional/local analyses are a critical complement to the national analyses, and are necessary to develop specific monitoring site recommendations. To this end, EPA must allow States and regional organizations sufficient time (e.g., at least 6 months) to conduct adequate regional/local analyses.

A copy of the FY 2000 national assessment can be found on the web at: www.epa.gov/ttn/amtic/netamap.

5.3 FY 2003 Regional Assessments

Each of the 10 EPA ROs was tasked with performing a regional network assessment in conjunction with its SLT partners. Although a framework was suggested, each RO undertook the assessment process differently, ranging from complex statistical functions to subjective site-by-site considerations. Some RO's have gone through the process of approving SLT network changes, while other RO's are awaiting finalization of the network assessment process before

approving changes. This lack of consistency points strongly to the need for network assessment guidance. Such guidance was deemed to be important by the CASAC Subcommittee on Monitoring at its July 2003 meeting. Because the regional assessment process is so far along at this point, there will not be a guidance structure in place for this initial round of assessments; however, a guidance document is now being developed which will help provide national consistency for subsequent assessments.

Though not yet final, the following summary of recommended network changes is intended to show the progress made by each of the Regional Offices:

- Region 1: Reductions in PM₁₀ FRM monitors; CO; and SO₂;
 Additions for PM_{2.5} continuous monitors; air toxic monitoring;
 Modifications for PM_{2.5} FRM's to support PM-coarse monitoring;
 Approach: Site-by-site situational analysis.
- Region 2: Reductions in PM₁₀ and CO monitors;
 Additions for PM_{2.5} continuous monitors;
 Approach: Site-by-site situational analysis.
- Region 3: Reductions in SO₂, NO₂, CO, Pb, PM₁₀
 Additions: Yet to be determined
 Approach: optimum network design function using 6 design
 considerations
- Region 4: Reductions in CO, PM₁₀, NO₂, lead, and SO₂ monitors;
 Additions: Yet to be determined;
 Approach: Statistical spatial analyses with considerations for population
 exposure, areal extent of violations, and sensitivity analyses.
- Region 5: Reductions in ozone, CO, PM₁₀, PM_{2.5}, lead, CO, SO₂, and NO₂;
 Additions: Yet to be determined;
 Approach: Statistical analyses for identifying high/low value sites; use of
 positive matrix factorization.
- Region 6: Reductions in PM₁₀, PM_{2.5}, CO, SO₂, NO_x, lead, ozone;
 Additions in continuous PM_{2.5}, NO_y, ozone;
 Relocations for PM_{2.5} FRM, SO₂, PM₁₀ FRM sites;
 Approach: State-by-state changes in consultation with each state.
- Region 7: Reductions in Pb, PM₁₀, CO, and PM_{2.5} monitors;
 Additions of 8 hour ozone sites, further additions considered;
 Relocations of 1 hour ozone sites;
 Approach: Statistical approach and consultation with State/Local agencies.

- Region 8: Reductions: Yet to be determined;
 Additions: Yet to be determined;
 Approach: Paired correlation rankings; comparisons to NAAQS; input and feedback from individual states.
- Region 9: Reductions: Yet to be determined;
 Additions: Yet to be determined;
 Approach: Statistical process similar to national assessment.
- Region 10: Reductions: PM₁₀ and PM_{2.5} FRM monitors; CO; NO₂;
 Additions: Continuous PM_{2.5} monitors;
 Approach: Correlation analyses; NAAQS comparisons; NCore design criteria.

It should be noted that the above summary represents work-in-progress, but is intended to provide a sense of the progress and types of approaches being taken by the various regions.

5.4 Guidance for Future Regional Network Assessments

Guidance and training materials are needed for future network assessments to provide more structure to the assessment process. The guidance must promote greater national consistency while allowing for flexibility due to the substantial differences among the regions. OAQPS is currently preparing a Regional Assessment Guideline Document which will be complete by the beginning of the next round of network assessments. With the next assessment due at the end of 2008, the regional assessments should begin no later than mid-2006. EPA is expecting to have a draft guidance document available for review by September 2004. Allowing 6-12 months thereafter for comments and document revisions, the guidance should be completed in mid 2005. This is in sufficient time prior to the start of the next round of network assessments.

It is with this in mind that the following steps are provided as a preliminary guide for the regional network assessments, recognizing that further elaboration is forthcoming in the guideline document currently under preparation:

- **Step 1: Description**
 Each assessment should contain some basic descriptive material of the region, to include topography, climate, population and trends, and general air quality conditions. This section should be considered more of a boilerplate section, needing updating as appropriate for each subsequent assessment.
- **Step 2: Network History**
 A description of the network evolution over at least the previous 10 years is important in helping to establish a sense of changes that have already been made in response to changing network needs. At a minimum, this description should

depict the total number of monitors in the region by pollutant and by year, either in graphical or tabular format. At best, this should be accompanied by a detailed table showing the history of each monitoring site. Then each successive five-year assessment simply appends the most recent five-year history to the previous summary, maintaining a continuous record of the monitoring networks.

- **Step 3: Statistical Analyses**

Each assessment should include some level of statistical analysis. At a minimum, site intercorrelations would help identify redundant sites. Also, some comparisons to the NAAQS and trend analyses would help determine sites which are well below the NAAQS and are not trending upward. Such sites, from a purely statistical standpoint, could be candidates for divestment. Analyses can be more complex, at the discretion of the Region. Examples include spatial analyses, factor analyses, as well as innovative approaches using weighting schemes such as those used in the National Assessment. The more detailed analyses can be used as important tools for determining the adequacy of existing monitoring sites. Examples of the types of statistical analyses that should be conducted can be found at - <http://www.epa.gov/ttn/amtic/netamap.html>

- **Step 4: Situational Analyses**

Apart from the statistics, there are a myriad of other factors which have bearing on network changes. These include, but are not limited to:

- Value of maintaining long-term trends
- Closeness to the NAAQS
- Population changes (e.g., new areas of growth)
- Existing maintenance plan and SIP requirements
- Sparseness of the existing network
- Special local circumstances (e.g., political factors)
- Needs of the scientific and health communities

These factors can be considered subjectively, or more objectively by first identifying the important factors and developing weighting schemes for each factor. The approach would be at the discretion of the Region.

- **Step 5: Suggested Changes**

Based on both the statistical and situational analyses, each Regional Office should prepare a recommended list of network changes, by pollutant and site, applicable to each state. Regional Office staff should engage in one or more workshops/meetings with State and local agencies for the purpose of sharing the results of the initial analyses and explaining the rationale for any suggested changes.

- **Step 6: Interactive Discussions**
State and local agencies should carefully review each of the changes suggested by the Regional Office. Deviations from the initially recommended changes are expected, but state and local agencies should present cogent rationale for the basis of any deviation. It is expected that state and local agencies will provide back to the Regional Offices their list of network changes including those which agree with the Regional Office recommendations, and those which differ. There may need to be one or more meetings between Regional Office staff and state and local agency staff to refine the changes which must ultimately be approved by the Regional Office.
- **Step 7: Final Recommendations**
Each Regional Office will provide a listing of the final changes to the air monitoring network within its jurisdiction. These are to be provided to OAQPS. The final listing should contain the following information:
 - Parameter changes (additions/removals/relocations)
 - Site changes (additions/removals/relocations)
 - A justification statement explaining (briefly) the rationale for the change
 - A timeline for implementation for each change.

5.5 Summary

The network assessment process is an integral part of the Strategy in that a more formalized, periodic network review will assure that the Nation's air monitoring networks adjust to meet the most pressing public, regulatory, and scientific needs.